

CLAIMS

1. A device (100) in a simulation system for simulating an interventional operation, said device (100) being arranged to receive a number of real instruments, preferably at
5 least two real instruments,
the device (100) comprising:
a number of moveable carriages (16A-16C) corresponding to the number of said real instruments,
a track (20),
10 an interconnecting member (26)
wherein said interconnecting member (26) interconnects said carriages (16A-16C) serially, each carriage (16A-16C) being provided with an opening for enabling reception of said real instruments, each carriage (16A-16C) further comprising members to receive and lock at least one real instrument, and members for receiving a movement
15 from said instrument and generating a force, fed back to said real instrument with respect to a simulation characteristic.
2. The device of claim 1, wherein said opening (22) is provided within said interconnecting member (26).
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3. The device of claim 1, wherein said interconnecting member (26) is a telescopic pipe.
4. The device of claim 1, wherein each carriage (16A-16B) comprises a detecting arrangement (48) for detecting the type of said real instrument inserted through said
25 interconnecting member (26).
5. The device of claim 1, wherein said device (100) is connected to a control unit (30) to measure the movement of said carriages (16A-16C) and control said movement by means of a speed control loop (86) and a position control loop (88).
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6. The device of claim 1, wherein said carriages (16A-16C) are arranged to move along said track (20).
7. The device of claim 1, wherein said carriage (16) has an actual position and a
35 simulated position, which actual carriage position determines the simulated carriage position from a scale table.

8. The device of claim 1, wherein said carriage (16A-16C) is connected through a transmission (18) for driving along said track (20).
9. The device of claim 1, wherein said carriage (16) is provided with a crank block (74),
5 which is arranged in a torque wheel (52).
10. The device of claim 1, wherein said crank block (74) is provided with a mating surface, which is pressed towards a collet (70) that grips the instrument wire.
- 10 11. The device of claim 1, wherein the force between a suspended plate (38) and a chassis (32), which is arranged on said carriage (16A-16C), is measured by means of a force sensor (40).
12. The device of claim 1, wherein said carriage (16) is provided with a detecting member
15 (48), which detects presence of an instrument in the carriage (16).
13. The device of claim 1, wherein said detecting member (48) is arranged to detect the type of each real instrument.
- 20 14. The device of claim 13, wherein said real instruments are categorized into said types with respect to at least one of the following characteristics; thickness, color, structure, material, identity and/or bar-code.
15. The device of claim 12, wherein said detecting member (48) is an optical sensor.
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16. The device of claim 1, wherein a first interconnecting member (26A) is arranged between said opening (22) and the first carriage (16A), a second interconnecting member (26B) is arranged between the first carriage (16A) and the second carriage (16B) and a third interconnecting member (26C) is arranged between the second
30 carriage (16B) and the third carriage (16C).
17. The device of claim 1, comprising a processing unit (10) for measuring a longitudinal movement and a movement of rotation, of the instrument.
- 35 18. The device of claim 1, comprising a processing unit (10), which provides force-feedback in the longitudinal direction and in the direction of rotation, of the real instrument.

19. The device of claim 1, wherein an end or part of said real instrument is simulated.
20. The device of claim 1, comprising a locking member (44), for clamping an instrument, which locking member (44) is attached to a central wall (42).
- 5 21. The device of claim 1, wherein said locking member (44) comprises a member for applying a torque.
22. The device of claim 1, wherein said crank block (74) is provided inside a torque wheel
10 (52), which crank block (74) moves in longitudinal direction and is fixed in the direction of rotation, relatively to the torque wheel (52).
23. A method of simulating a interventional operation by means of a device (100) in a simulation system, said device (100) being arranged to receive a number of real
15 instruments, preferably at least two real instruments, the device (100) comprising:
a number of moveable carriages (16A-16C) corresponding to the number of said instruments,
a track (20),
an interconnecting member (26),
20 the method comprising the steps of inserting a number of real instruments into said device (100), receiving said real instruments by each carriage, which are interconnected serially, by receiving and locking at least one instrument, each carriage (16A-16C) further comprising members for receiving a movement from said real instrument and generating a force fed back to said real instrument with respect to a
25 simulation characteristic.
24. A device according to any one of claims 1-22 in a simulator system, preferably an interventional procedure simulator system, comprising at least a first and a second displaceable member (16A-16C), a control system comprising:
30 ▪ a first controller (F1(s)), controlling the speed of said first displaceable member (16A-16C) towards a set value (CDV),
 ▪ a second controller (F2(s)), for combining an error in a position (CAP) and a speed of said second, previous displaceable member (PCAV) to a set speed for the first member, wherein the second controller (F2) controls $CDV = C1 * (CAP - PCAV) + C2 * PCAV$, wherein C1 and C2 are constants.
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25. A device according to any one of claims 1-22 in a simulator system, preferably an interventional procedure simulator system, comprising an arrangement for detecting a real instrument to be simulated, wherein said arrangement comprises identification

means for identifying said real instrument.

26. The interventional procedure of claim 25, wherein said arrangement for detecting an instrument, comprises at least one IR diode (104) and at least one IR phototransistor (106).
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27. The interventional procedure of claim 25, wherein said identification means consists of at least one of thickness, color, structure, material of said real instrument, identity and/or bar-code.
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28. A device according to any one of claims 1-22 in a simulator system, preferably an interventional procedure simulator system, further comprising members to receive and lock a real instrument to be simulated, a control unit (30) comprising a force sensor (40), wherein said control unit (30) controls towards a demand force value (DF), and a force that a user experiences in the instrument is measured with the force sensor (40), and a signal from the force sensor (40) is fed back in a force feedback control loop (102) towards a set force.
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29. A device according to any one of claims 1-22 in a simulator system, preferably an interventional procedure simulator system, comprising an arrangement for generating a resistance in a simulated real instrument, the arrangement comprising a control unit (30), a force sensor (40), a force feedback control loop (102) for controlling an actuator device for driving an instrument receiver member (16) in a direction, and an inner force control loop (112) wherein
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- said force sensor is arranged for measuring said resistance, a signal from the force sensor is fed back in said inner force control loop (112) that controls, with a loop amplification (K) provided by said control unit, towards a set force value (SF) provided by said control unit and said inner force control loop (112) controlling said actuator.
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30. The simulator system of claim 29, wherein said control unit (30) controls said loop amplification (K) to achieve a said resistance.
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31. The simulator system of claim 29 or 30, wherein said control unit (30) controls said set force (SF) to achieve a said resistance.
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32. A device according to any one of claims 1-22 in a simulator system, preferably an interventional procedure simulator system, comprising an arrangement for generating a resistance in a simulated real instrument, an arrangement for receiving and fixing a part of a real instrument in a device for measuring instrument movement and feeding

back a force to said real instrument, said arrangement comprising a member for clamping said real instrument.

5 33. The arrangement of claim 32, comprising a crank block (74), which is arranged in a torque wheel (52), said crank block (74) being movable in a longitudinal direction inside said torque wheel (52).

10 34. The arrangement of claim 33, wherein said crank block (74) is provided with a mating surface, which is pressed towards a collet (70) that grips said instrument part.